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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: J. Taniguchi Attorney Docket No.: NAI124945
Application No.: 10/528,480 Art Unit: 1792 / Confirmation No: 8460
Filed: October 25, 2005 Examiner: Shamim Ahmed
Title: SURFACE PROCESSING METHOD

RESPONSE AFTER FINAL

Seattle, Washington 98101

September 24, 2008

TO THE COMMISSIONER FOR PATENTS:

REMARKS

Claims 1, 2, 4, 5, 7, 8, 11-14, 16, 17, 28-32, 36-38, 42-49, 53, and 59-62 are pending and have been rejected. Reconsideration and allowance of all pending claims is respectfully requested in view of the following remarks.

The Claimed Invention

The claims include independent Claims 1, 2, 11, 13, 30, 42, 61, and 62. Independent Claim 1 recites a method for etching a spin-on-glass (SOG) layer exposed to an electron beam, wherein the depth of the etched area is dependent on the accelerating voltage of the electron gun.

Claim 2 recites a method similar to Claim 1 that includes a laminated body having a sample material, an intermediate layer formed on the sample material, and an SOG layer. The SOG layer is etched similarly to the recitation of Claim 1.

Claim 11 recites a method for etching a sample material, similar to that recited in Claim 2, by etching an SOG layer that has been patterned by the method of Claim 1.

Claim 13 recites a method for fixing particulates in an SOG layer, including the steps of exposing a particulate-containing SOG layer with an electron beam and etching the exposed

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SOG layer so as to expose the particulates in the SOG. The magnitude of accelerating voltage of the electron gun determines the depth of the exposed/etched SOG layer.

Claim 30 recites a method for forming multiple layers of features in an SOG including the steps of irradiating a first SOG layer with an electron beam; irradiating a second SOG layer, deposited on the first SOG; and removing the exposed portions from both layers, where the magnitude of accelerating voltage of the electron gun determines the depth of the exposed/etched SOG layers.

Claim 42 recites a method for patterning a mask material through irradiation by electron beam, where the magnitude of accelerating voltage of the electron gun determines the depth of the exposed/etched mask layer.

Claim 61 recites a method for making a multi-stepped SOG layer structure including the steps of irradiating the surface of an SOG layer and removing the exposed portions of the SOG layer. The magnitude of accelerating voltage of the electron gun determines the depth of the exposed/etched SOG layer and the resulting structure is a multi-step structure.

Claim 62 recites a method similar to Claim 61 that includes a laminated body having a sample material, an intermediate layer formed on the sample material, and an SOG layer. The SOG layer is etched similarly to the recitation of Claim 61.

The Rejection of Claims 1, 2, 5, 7, 11, 13, 14, 28, 29, 42, 43, 47, and 59-62 Under 35 U.S.C. § 103(a) In View of the Park and Yoshimura et al. References

Claims 1, 2, 5, 7, 11, 13, 14, 28, 29, 42, 43, 47, and 59-62 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over the patent to Park (U.S. Patent No. 5,743,998, hereinafter "Park") in view of the patent to Yoshimura et al. (U.S. Patent No. 5,402,410, hereinafter "Yoshimura et al."). Withdrawal of this rejection is respectfully requested for the following reasons.

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As can be seen from the above synopses of the independent claims, Claims 1, 2, 11, 13, 42, 61, and 62 are limited by the recitation that the magnitude of the accelerating voltage of the electron gun determines the depth of exposure of the irradiated material (e.g., SOG) and thus the depth of etch of the material when exposed to an etchant. It is noted that neither the Park nor Yoshimura et al. references teach the depth of exposure and subsequent etching being controlled by the accelerating voltage from an electron gun. The Office Action notes at page 3 that the Park reference does not teach that the magnitude of the accelerating voltage of the electron gun is changed such that the depth of the exposed part of the SOG layer is controlled. The Office Action states that the Yoshimura et al. reference teaches the use of accelerating voltage to form patterns with different depths or heights.

The Yoshimura et al. reference teaches the formation of steps of an irradiated and etched material having different heights based on electron dose, and not electron gun accelerating voltage. The reference clearly states that the varying heights of features are generated through control of electron dose, as described at Col. 9, lines 38-40, the "height of a pattern following the formation was in accordance with the electron beam dose" (emphasis added). Accelerating voltage is not varied and is instead kept constant (30 kV in the passage cited in the Office Action at Col. 8, lines 65-69) for writing a pattern, and changed only to read the written pattern (reading is performed at 1 kV in the example at Col. 10, lines 39-41).

It is known to those of skill in the art of electron beam technology that the accelerating voltage of an electron beam is entirely separate from the electron dose delivered to a substrate. Additionally, the control of depth of exposure by varying accelerating voltage is particularly important in the claimed invention because such a technique can be used on targets that are insulating, semiconducting, or conductive; whereas exposure-depth control by electron dose is

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highly susceptible to the conductivity of the target surface and thus lacks uniformity across varying target materials.

Because the cited references fail to teach, suggest, or render obvious varying accelerating voltage of an electron gun to control the exposure depth of a target material, it is submitted that the claimed invention is not obvious in view of the cited references and withdrawal of this ground for rejection is respectfully requested.

With further regard to independent Claim 13, which, as described above, teaches a method that includes exposing a particulate-containing SOG layer, it is noted that neither of the cited references teaches, suggests, nor renders obvious such a use of particulates. Particulates are, in fact, never mentioned in the cited references. Withdrawal of the rejection of Claim 13 is once again requested.

With further regard to independent Claims 61, and 62, both of which recite, as described above, structures having a multi-stepped structure to the SOG layer, which are not taught by the cited references. Such a stepped structure typically results from exposing different areas of the SOG to different accelerating voltages of electron beam, as described in the application as filed in the Second Embodiment, the description of which begins on page 14, and which can be better understood with reference to Figures 3(a)-(f). Because multi-step structures resulting from different electron beam accelerating voltages are not taught, suggested, or made obvious by the cited references, withdrawal of this ground for rejection is once again requested for Claims 61 and 62.

The Rejection of Claims 2, 7-8, 11, 13-14, 36, 38, 42-44, 47, and 60-62 Under 35 U.S.C. § 103(a) in View of the Miyata et al. and Yoshimura et al. References

Claims 2, 7-8, 11, 13-14, 36, 38, 42-44, 47, and 60-62 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the patent to Miyata et al. (U.S. Patent No. 5,888,846,

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hereinafter "Miyata et al.") in view of the patent to Yoshimura et al. Withdrawal of this rejection is respectfully requested for the following reasons.

Miyata et al. teaches a method for microfabricating diamond including the steps of forming a resist layer of spin-on glass material on diamond and lithographically defining the spin-on glass layer for etching so as to transfer the pattern from the SOG to the diamond. The Office Action notes on page 4 that Miyata et al. does not teach that the magnitude of an accelerating voltage of an electron gun is changed such that the depth of the exposed part of the SOG layer is controlled. Once again, the Office Action relies upon Yoshimura et al. to teach such a feature.

As described above, the Yoshimura et al. reference does not teach the formation of different etch depths of a material based on varying electron gun accelerating voltage, but instead teaches such variation using electron dose. As a result, the combination of the Miyata et al. and Yoshimura et al. references does not teach, suggest, or make obvious the claimed invention. Withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 4, 16-17, 45, 46, 48, and 49 Under 35 U.S.C. § 103(a) in View of the Miyata et al. and Hashimoto et al. References

Claims 4, 16-17, 45, 46, 48, and 49 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Miyata et al. in view of Hashimoto et al. (U.S. Patent No. 5,169,494). Withdrawal of this rejection is respectfully requested for the following reasons.

The Examiner relies upon Miyata et al., as described above, and additionally relies on Hashimoto et al. as teaching the use of PMMA to form an intermediate resist layer.

As described above, the Miyata et al. reference, particularly when combined with the Yoshimura et al. reference, does not teach, suggest, or make obvious the claimed invention. Hashimoto et al. does not cure the deficiencies of the Miyata et al. and Yoshimura et al.

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references because it does not teach that the magnitude of the accelerating voltage of the electron gun is changed such that the depth of the exposed part of the SOG layer is controlled.

Because the combination of the Miyata et al. and Hashimoto et al. references does not teach, suggest, or make obvious the claimed invention, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 30-32 and 37 Under 35 U.S.C. § 103(a) in View of the Park, Yoshimura et al., and Miyata et al. References

Claims 30-32 and 37 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Park in view of Yoshimura et al. and further in view of Miyata et al.

As described above, Claim 30 recites a method forming multiple layers of features in an SOG, including the steps of irradiating both a first and a second SOG layer and etching the layers to form a multiply-etched structure.

The Park reference is relied upon as teaching that an SOG can be used to expose a first and second SOG layer for forming multilayer devices. The Examiner has cited Col. 10, lines 21-60, as teaching exposing multiple SOG layers to form a multilayer structure. However, it is noted that the first layer of spin-on glass 42 (as illustrated in Figures 5A-5E) is a planarization layer that is used to even out surface irregularities (Col. 10, lines 24-26). A conductive layer 44 is deposited on the SOG layer 42 and a second SOG layer 46 is deposited on the conductive layer 44 (Col. 10, lines 26-31). As can be seen clearly by following the progression of device fabrication from Figures 5A-5E, the top SOG layer 46 is exposed in Figure 5B and etched to yield the structure of Figure 5C, where the conductive layer 44 is exposed. In Figure 5D, the conductive layer 44 is etched so that the bottom SOG layer 42 is exposed. Finally, in Figure 5E, the top SOG layer 46 and the bottom SOG layer 42 are both etched. The bottom SOG layer 42 is never exposed to an electron beam, but is etched through

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traditional thin film etching techniques, as is evidenced by the global etching of the SOG layers seen in Figure 5D, resulting in all of the top SOG layer 46 being etched away, as well as the unmasked portion of the bottom SOG layer 42. Thus, the Park reference does not teach a method by which both the top SOG layer 46 and the bottom SOG layer 42 are both exposed to an electron beam and developed as a resist. Park teaches that only the top SOG layer 46 is used as a resist and the bottom SOG layer 42 is used not as a resist but instead as a planarization layer.

Because the cited references do not teach, suggest, or make obvious all of the aspects of Claims 30-32 and 37, applicant respectfully requests the withdrawal of this ground for rejection. Rejection of Claims 12 and 53 Under 35 U.S.C. § 103(a) in View of the Miyata et al. and Yoshimura et al. References and Further in View of Applicant's Admission

Claims 12 and 53 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Miyata et al. in view of Yoshimura et al. and further in view of applicant's admission.

The Office Action states that the applicant's own admission as to the known use of lithography to create a mold when combined with the teachings of Miyata et al. renders Claims 12 and 53 obvious. For the reasons stated in the above sections addressing the Miyata et al. reference as modified by the Yoshimura et al. reference, applicant submits that the applicant's own admissions do not cure the deficiencies of the combination of Miyata et al. and Yoshimura et al. Thus, Claims 12 and 53 are not obvious in view of the cited references and withdrawal of this ground for rejection is respectfully requested.

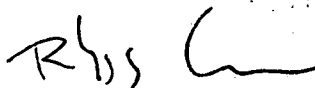
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CONCLUSION

In view of the above comments, applicant believes that Claims 1, 2, 4, 5, 7, 8, 11-14, 16, 17, 28-32, 36-38, 42-49, 53, and 59-62 are in condition for allowance. If any issues remain that may be expeditiously addressed in a telephone interview, the Examiner is encouraged to telephone applicant's attorney at 206.695.1698.

Respectfully submitted,

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